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# The Role of the Intellectual Property Rights Regime for Foreign Investors in Post-Socialist Economies[1]


## Abstract

We integrate international business theory on foreign direct investment (FDI) with institutional theory on intellectual property rights (IPR) to explain characteristics and behaviour of foreign investment subsidiaries in Central East Europe, a region with an IPR regime-gap vis-à-vis West European countries. We start from the premise that FDI may play a crucial role for technological catch-up development in Central East Europe via technology and knowledge transfer. By use of a unique dataset generated at the IWH in collaboration with a European consortium in the framework of an EU-project, we assess the role played by the IPR regimes in a selection of CEE countries as a factor for corporate governance and control of foreign invested subsidiaries, for their own technological activity, their trade relationships, and networking partners for technological activity. As a specific novelty to the literature, we assess the influence of the strength of IPR regimes on corporate control of subsidiaries and conclude that IPR-sensitive foreign investments tend to have lower functional autonomy, tend to cooperate more intensively within their transnational network and yet are still technologically more active than less IPR-sensitive subsidiaries. In terms of economic policy, this leads to the conclusion that the FDI will have a larger developmental impact if the IPR regime in the host economy is sufficiently strict.



JEL: F21, F23, O31, O34

Keywords: Foreign Direct Investment, Intellectual Property Rights, Technology Transfer, Corporate Governance and Control, R&D and Innovation



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# The Role of the Intellectual Property Rights Regime for Foreign Investors in Post-Socialist Economies

## Zusammenfassung

Wir kombinieren die zwei Theoriegebäude der International-Business- und der Institutionenökonomie, um die Charakteristika und das Verhalten von ausländischen Direktinvestitionen (ADI) in den Ländern Mittel- und Osteuropas zu untersuchen, die sich unter anderem durch einen relativ zu den entwickelteren westlichen Ländern geringeren Schutz intellektueller Eigentumsrechte auszeichnen. Wir gehen von der Annahme aus, dass ADIs einen wichtigen Entwicklungsbeitrag in diesen Ländern leisten können, indem sie Technologie und Wissen transportieren. Unter Verwendung einer einzigartigen Datenbank, die durch das Institut für Wirtschaftsforschung Halle (IWH) in Kooperation mit einem internationalen Konsortium im Rahmen eines EU-Projektes generiert wurde, untersuchen wir für eine Auswahl von Post-Transformationsländern die Rolle, die das Regime intellektueller Eigentumsrechte (IPR-Regime) für die entwicklungsfördernden Potenziale von ADI hat. Diese Rolle wird vermittelt durch die Corporate-Governance-Strukturen zwischen Investoren und Töchtern, die technologische Aktivität von Tochterunternehmen in der Region, ihre Handelsbeziehungen insbesondere mit der Gastökonomie und die Netzwerkbeziehungen für ihre technologische Aktivität. Ein Neuigkeitswert der Untersuchung besteht in der Analyse des Verhältnisses zwischen der Stärke des IPR-Regimes und der Kontrollmechanismen zwischen Investoren und Töchtern. Die Ergebnisse deuten darauf hin, dass diejenigen ADI-Projekte, die eines besonderen Schutzes durch das IPR-Regime bedürfen, typischerweise eine geringere funktionelle Autonomie aufweisen, sich in ihren Kooperationen stärker auf das Netzwerk des ausländischen Investors konzentrieren und dennoch eine höhere technologische Aktivität aufweisen. Für die Wirtschaftspolitik kann daraus geschlossen werden, dass ADI dann einen besonders intensiven Entwicklungsbeitrag leisten können, wenn das Gastland sein IPR-Regime möglichst streng ausgestaltet.

JEL: F21, F23, O31, O34

Schlüsselwörter: ausländische Direktinvestitionen, intellektuelle Eigentumsrechte, Technologietransfer, Corporate Governance, forschung und Entwicklung, Innovation

# The Role of the Intellectual Property Rights Regime for Foreign Investors in Post-Socialist Economies

## 1 Introduction

Foreign direct investment plays a particularly important role for catch-up development where investment from technologically advanced regions in less advanced regions leads to the transfer and dissemination of knowledge into the host economy. This may be particularly important for post-transition economies in Central East Europe (CEE): here, integration into the European division of labour in general and technological catching up remain the most important tasks. Those economies were disconnected from economic activity and technical progress in the Western world for an extended period of time, significant productivity gaps are still prevalent, and their closure constitutes the prime concern for catch-up development to West European levels (see e.g. Stephan 2003). Whilst foreign direct investment (FDI) is largely perceived as the one vehicle in support of such catching up, it remains an open issue of whether inflowing FDI actually serves to assist their host economies by way of technology and knowledge transfer or whether low factor costs (here mainly labour costs) reduce FDI to 'extended workbenches' and make them a rather ineffective tool for catch-up development. Where investors have a large ownership advantage in terms of their endowment with knowledge, the question emerges as to how investors protect their knowledge from unwanted use by (potential) competitors in the investment-hosting economy, and whether foreign investors actually transfer significant technology and knowledge to host economies with relatively weaker intellectual property rights regimes (IPR regimes). The scores for the 'IP Rights Protection' within the 2007 'International Property Rights Index' (of the Washington-based IPRI) clearly rate the countries in CEE lower than the typical countries where foreign investors in CEE originate: Germany ranks first with a level of 8.8 on a scale between 0 (intellectual property protection is weak or non-existent) to 10 (is equal to the world's most stringent protection), 8.6 for Finland, 8.3 for the UK, 8.2 for France, 8.2 for Japan, 8.0 for the US, and 8.6 for Austria. For the CEEs that form part of our analysis, the scores are much lower: 3.4 for Romania, 5.3 for Poland, 4.5 for Croatia (was not available in the 2007-report, the index provided here is from the 2008-report), and 5.8 for Slovenia (was also not available in the 2007-report, index is from the 2008-report) (http://internationalpropertyrightsindex.org, accessed April 2008). The 'Protection of intellectual property' section of the 2005/2006 Global Competitiveness Report of the World Economic Forum (WEF) lends further support to this: Germany again scores first with 6.6 (where 7 is equal to the world's most stringent intellectual property protection and 1 equals weak or nonexistent protection). Finland scores 6.4, UK 6.2, France and

Japan 5.9, US 5.7, and Austria 5.6. Amongst the post transition economies rated, we find: 3.0 for Romania, 3.6 for Poland, 3.2 for Croatia, and 4.4 for Slovenia.

The main research question of this paper is hence whether particularly knowledge-intensive investors in a selection of CEE countries are in fact particularly active in terms of technology and rely on their existing IPR regimes to protect unwarranted use of the knowledge advantage? Or do those investors rather refrain from cooperating and trading with the local economy and prefer extra-close ties of control with their subsidiaries to prevent the diffusion of technology? The focus here is on the influence of IPR regimes in Central East Europe on the behaviour and characteristics of their inward foreign direct investment, including corporate governance/control of subsidiaries and their trade and networking partners for their technological activity. There is a striking gap in the literature where the two issues of transnational companies (TNC) and IPR merge: so far, literature is mainly concerned with the *kind* of foreign investment made in weak IPR regimes and rather little is known about the *behaviour* and *corporate governance* of FDI in weak IPR systems.

For our analysis, we use a unique dataset on FDI subsidiaries in East Germany, Poland, Croatia, Romania, and Slovenia (the IWH-FDI database). Following a brief overview of the state-of-the-art in research on the effect of IPR on FDI, the paper develops a set of testable hypothesis derived from this literature. After describing the data used and a short presentation of the most important stylised facts of the issues at hand, empirical analysis is used to test our hypothesis. The final chapter discusses the results of the empirical analysis in light of economic policy where such is dedicated to improving the conditions for technologically-based economic catching up via FDI in Central East Europe.

# 2 Theory and Related Empirical Works

Most of the literature on the nexus between FDI and IPR is concerned with the influence of IPR on the *extent* and *character* that internationalisation decisions of firms assume. Internationalisation describes a firm moving beyond its own national borders either to service foreign markets or to acquire assets abroad, and may take the form of exporting, foreign direct investment, joint ventures, or licensing (see for the transition countries from the point of view of institutions and transaction costs: Meyer 2001). All those forms of internationalisation are in fact associated with the danger that the firm may lose control over its original knowledge-based asset to competing firms – even though to varying degrees. Amongst the factors affecting this danger, the institution of the national IPR regime – or rather its effective implementation – is certainly the most prominent one. Institutions (such as the IPR regime) not only define the rules of the game, they also determine directly "what arrows a firm has in its quiver as it struggles to formulate and implement strategy and to create competitive advantage" (Ingram and Silverman 2002, p. 20) or defend its intellectual property, as we would want to add at this point: where the IPR regime offers powerful legal instruments to fight unwarranted dissipation of knowledge assets, a firm may feel more comfortable with foreign investments and vice versa (for an appreciation of institutional theory in the area of foreign investors' strategies, see Meyer and Peng 2005, p. 610-611).

The OLI paradigm of Dunning (1993) is concerned with foreign direct investment as one form of internationalisation, but the model can be generalized: a firm will only undertake a FDI in a certain country (or internationalise), if the firm possesses an ownership advantage. This ownership advantage allows the internationalising firm to compete more successfully than domestic firms in the host economy. This advantage is needed to compensate the disadvantage the foreign firm faces in an unknown foreign environment. Still, the internationalising firm containing the ownership advantage could export to the new foreign market instead of establishing a FDI subsidiary. Hence, in order to distinguish between exporting and FDI, the host economy has to offer an additional localization advantage: the host country has to possess attributes for production that are superior to the home country of the foreign firm. Maskus (1998, p. 121-122) emphasises the role of different *kinds of knowledge* for inflows of FDI: the knowledge giving rise to the ownership advantage will predominantly be of an intangible character (e.g. trademark or reputation for quality) or a product or production process inaccessible to other firms (such as a patent or trade secret), and 'multiplant economies' can best be exploited by firms developing easily transferable knowledge that needs protection from unwarranted use.

With respect to *kind of internationalisation*, literature holds that firms will bias their internationalisation efforts on exporting and less on FDI where weak IPR regimes offer little protection of ownership advantages, whereas other forms like joint ventures and licensing take precedence in environments with strong IPR systems (e.g. Nunnenkamp

and Spatz 2003; Smarzynska 2004). Park and Lippoldt (2005) as well as Nicholson (2007) come to the conclusion that at certain levels of IPR protection, FDI may will be substituted by licensing.

The amount of FDI-inflows will tend to increase with the strength of IPR protection (e.g. Braga and Fink 1989, p. 172; Maskus 1998), as does the amount of direct technology transferred (Branstetter et al. 2005). Likewise will the quality of technology transferred in internationalisation strategies increase (e.g. Rockett 1990; Park and Lippoldt 2005). The explanation behind these patterns is that companies that possess valuable knowledge assets are deterred from investing and transferring sensitive knowledge into countries where their knowledge can easily be copied and used by competitors without fear of sanctions. Pertaining to transition economies in Eastern Europe, case studies conducted by Sharp and Barz (1997) conclude for the chemical and pharmaceutical industries that companies pay close attention to the risk of piracy due to weak IPR protection, and are therefore sceptical about transferring technology to those countries. Other empirical studies show a more complex relationship between IPR protection and FDI: e.g. Park and Lippoldt (2003) find a positive association of IPR and FDI, but the effect depends on the starting point of the IPR regime. The reform of a weaker initial level of IPR protection leads to a higher rise in FDI. For firms, changes to the better appear to have been more important than the current national state-of-the-art in the strength of the IPR system.

Because sectors differ in the ability to generate product and process innovations and to copy knowledge and technology from others (imitation), the IPR issue is typically treated as an *industrial branch-specific* problem: industries like the chemical or pharmaceuticals depend more heavily on IPR protection whereas sectors like manufacturing of basic metals or food products are rather less affected by the quality of the IPR regime in the host economy. The distinction between IPR-sensitive sectors and IPR-insensitive sectors was first described by Mansfield (1986, later revisited in 1995) and is ever since widely cited by other researchers in papers on this issue (see e.g. Lee and Mansfield 1996; Maskus 2000, Table 1, p. 6; Nunnenkamp and Spatz 2003; Ostergard 2000; Smarzynska 2004 and UNCTAD 1993). Extending the list, Band and Katoh (1995) and Ebanks (1989) find the software and entertainment industries as particularly depending on IPR protection via patent and copyright (alas, those sectors are not included in our database). Possibly, the 1986-study could not identify those two sectors as IPR-sensitive, because technology in these fields evolved in large leaps ever since that time. The issue is also treated as specific to the *kind of technology* involved: standardized, labour-intensive production depends on IPRs to a lesser degree than complex but easily copied product-technologies such as pharmaceuticals (see e.g. Maskus 2000).

Perhaps even more importantly, the decision about the extent and character of internationalisation is treated as specific to the *type of investment or business functions* of the subsidiary: here, distinction is made between sales and distribution outlets (depending the least on IPR regimes), rudimentary production and assembly, manufacture of com-

ponents or complete products, and finally R&D as depending the most on strong IPR protection (e.g. Mansfield 1993, p. 112; Mansfield 1995). With respect to R&D, Nunnenkamp and Spatz (2003) find that the strengthening of the IPR regime not only affects the amount of inward FDI but also the amount of R&D expenditure by foreign subsidiaries (this is complemented by an increase in value added and exports created by subsidiaries, ibid., p. 39). Lee and Mansfield (1996) hold for the chemical industry that FDI subsidiaries in countries with strong IPR regimes tend to conduct more R&D and have a higher production than their counterparts in weaker IPR systems. Maskus (1998) comes to the conclusion that a strengthening of an IPR regime in a country is followed by an increase in the number of patent applications by foreign subsidiaries and an increase in affiliate sales of patented products. Nunnenkamp and Spatz (2003) find that a shift to a stronger IPR system raises the amount of exports and R&D by FDI subsidiaries. Interestingly, some foreign investment subsidiaries often conduct R&D even if their host economy IPR regime is considered weak (Zhao 2004). Examining this puzzle, Zhao coins the expression of "internalization-arbitrage" (p. 2) by which multinational enterprises (MNE) locate only a particular part of R&D in less protected host economies. This part is either not easily copied or provides little value without its complementary R&D (which is then located in better protected locations of the MNE). Possibly, some of this R&D is targeted at increasing the absorptive capabilities at the technology-receiving end (Cohen and Levinthal 1989). Additional explanations for this puzzle may be found in Levin et al. (1987) and include mechanisms like the exploitation of lead time or head start, moving rapidly down the learning curve, the use of complementary sales and service capabilities, and finally outright secrecy[2], to exploit technology and knowledge generated in locations with weak protection.

As a further dimension of the relationship between FDI and IPR, the literature assesses the *degree of ownership* in the foreign invested company (e.g. Nunnenkamp and Spatz 2003, p. 14 or Braga and Fink 1989, p. 173), with weaker IPR regimes typically associated with higher ownership shares. It is in particular this last dimension that comes close to the corporate governance issue targeted in this analysis.

Our paper makes use of the insights generated by this literature and focuses on the character of international production-contracting with an intermediate level of danger involved for the firm to lose its ownership advantage: foreign direct investment. Here, the investor comes sufficiently close to the foreign host economy production system to make productive use of its potentials, and is still able to keep its knowledge-based assets from unwanted exploitation by host economy competitors by closely controlling its subsidiary.

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2 A survey of nearly 1 500 R&D manufacturing laboratories in the United States shows that 51% of innovations were protected by trade secrets and only 35% by patents (*Cohen et al.* 2000). This promotes the authors of the World Investment Report (*UNCTAD* 2005, p. 209) to assume that "[t]o the extent that the R&D process involves sensitive information, TNCs will always seek to protect trade secrets against disclosure."

# 3 Hypothesis about the Role of IPR Regimes for Foreign Investors' Strategies

According to the literature, the amount and quality of direct technology transferred to FDI subsidiaries positively depends on the strength of the protection of firm-owned knowledge by the IPR regime (see e.g. Rockett 1990; Park and Lippoldt 2005; Branstetter et al. 2005). We assume that an FDI subsidiary will become sensitive to the strength of the IPR regime if the product and process technology it receives from the foreign investor is particularly important or if the subsidiary has acquired and purchased external knowledge. This we use to proxy the firm-specific sensitivity to IPR protection of knowledge ownership (see the below construction of the proxy).

We learn from Mansfield (1993, p. 112, and 1995) that with sales and distribution outlets depending the least on IPR regimes, FDI projects in host economies with weaker IPR regimes will be able to carry knowledge and technology worth protecting if the main focus is on a mandate of sales and distribution outlets. We may extend this line of reasoning to other strategic motives: following key clients that moved to the host economy may also offer some guarantee that the main cooperation partner of the subsidiary belongs to a group which already has a proven record of appreciating intellectual property rights. If a foreign investment is made with a focus on location-bound natural resources, the subsidiary will tend to be rather vertically integrated with the parent firms with little interaction necessary with the host economy. The danger of losing intellectual property may hence be rather little here as well. Quite on the contrary, however, if accessing location-bound knowledge, skills, and technology, e.g. via cooperation with host economy local firms and organisations, is the main strategic motive, then this should coincide with rather lower levels of IPR sensitivity, as here the danger of leaking of firm-specific knowledge is clearly relevant.[3] Our first set of four hypotheses are hence that:

H1: The more important the strategic motive of the foreign investor to access a new market or to increase the existing share on the domestic market, the more an FDI may afford to be sensitive to the strength of the IPR system in the host economy if the IPR regime there is weaker.

H2: The more important the strategic motive of the foreign investor to follow key clients abroad, the more an FDI may afford to be sensitive to the strength of the IPR system in the host economy if the IPR regime there is weaker.

[3] We do not think that the strategic motive to increase efficiency across the foreign owner network (e.g. via lower labour cost in our selection of host countries) should influence the degree to which an FDI project is sensitive to IPR protection. To control for firm-heterogeneity, this strategic motive is however included in the analysis.

H3: The more important the strategic motive of the foreign investor to tap location-bound natural resources, the more an FDI may afford to be sensitive to the strength of the IPR system in the host economy if the IPR regime there is weaker.

H4: The more important the strategic motive of the foreign investor to access location-bound knowledge, skills, and technology, the *less* an FDI may afford to be sensitive to the strength of the IPR system in the host economy if the IPR regime there is weaker.

From Lee and Mansfield (1996) as well as Nunnenkamp and Spatz (2003), we learn that parent companies tend to place less R&D with foreign investment subsidiaries in host countries with less stringent IPR regimes. This is particularly pronounced for subsidiaries in the sectors that depend heavily on IPR protection. We hence hypothesise:

H5: The more an FDI is sensitive to the strength of the IPR system in the host economy, the less it will conduct R&D in the host economy if the IPR regime there is weaker.

Qualifying this hypothesis, we can alternatively follow Zhao (2004) in that multinational firms are able to substitute the weakness of IPR regimes by "internalization-arbitrage" and Levin et al. (1987) stressing the role of competitive advantage by lead time or head start, by rapidly moving down the learning curve, by use of complementary sales and service capabilities, and by way of business-secrecy. The opposite may hence also turn out to be true.

Spending less on R&D, subsidiaries will likewise generate a lower number of innovations. Following Maskus (1998), we should assume that the stronger a host economy IPR regime, the higher the number of innovations and patent applications by the foreign subsidiary. This gives rise to the hypothesis:

H6: The more an FDI is sensitive to the strength of the IPR system in the host economy, the less it will generate innovations in the host economy if the IPR regime there is weaker.

If TNCs do locate R&D and generate innovations in countries with weak IPR systems, they will tend to protect their newly generated knowledge. Nunnenkamp and Spatz (2003, p. 14) and Braga and Fink (1989, p. 173 suggest that a foreign investor may alleviate the weaknesses of a weak IPR regime by way of corporate control. Controlling subsidiaries may involve a high equity share or alternatively may involve the tying of the subsidiary's business functions to the control of the parent company. The autonomy-issue is in fact an original contribution to the literature: whilst autonomy as corporate governance-instrument does form part in the international business literature with respect to enterprise restructuring and performance (see e.g. Buck et al. 2003) or with respect to technology transfer from parent to subsidiary (see e.g. Stephan et al. 2005). The foreign investment subsidiaries corporate control-issue has so far however not been ap-

plied to the issue of protection of intellectual ownership and IPR. In this context, involving two not necessarily complementary tools[4] to substitute a weak IPR system, we hypothesise:

H7a: The more an FDI is sensitive to the strength of the IPR system in the host economy, the higher the equity share of the parent in the subsidiary if the IPR regime is weaker.

H7b: The more an FDI is sensitive to the strength of the IPR system in the host economy, the lower the autonomy of the subsidiary on its business functions if the IPR regime is weaker.

Another way of controlling subsidiaries may well take a form of restricting the cooperation conducted by the subsidiary to the members of the TNC's network: this way, the subsidiary is restricted in its tapping of sources for R&D and innovation to the TNC network and hence may reduce the risk of losing control of its ownership advantages in terms of knowledge and technology. This translates into the hypothesis:

H8: The more an FDI is sensitive to the strength of the IPR system in the host economy, the more it will tend to cooperate technologically with the foreign direct investment network and the less with domestic players if the IPR regime is weaker.

It is in particular the two latter control-mechanisms (autonomy belonging to corporate governance and intra-TNC cooperation describing a form of behaviour) that may be considered new to the literature. To the best of our knowledge, these issues have not yet been analysed in the framework of the relationship between FDI and IPR.

4 From the literature, we would typically expect corporate governance via ownership shares and functional autonomy to be positively correlated. In transition economies, this relationship seems to be more complicated (see e.g. *Karhunen et al.*, 2008).

# 4 Data and Stylised Facts

For the analysis, we use the IWH-Foreign Direct Investment Database. In this micro-database, 736 foreign investment subsidiaries from East Germany, Poland, Croatia, Romania, and Slovenia were interrogated by use of a 5-page questionnaire in the course of 2006 and early 2007. The questions focus on 4 areas: (i) characterisation of FDIs (size, sector, strategic motive, etc.), (ii) relationship between subsidiaries and headquarter (corporate governance literature), (iii) subsidiaries' own technological activities (R&D and innovation), and (iv) technological linkages with the host economy (i.e. embeddedness or role of FDI in local innovation system). Foreign invested subsidiaries were defined with a foreign equity share[5] of at least 10 per cent. The questionnaires were sent out either to the firms and/or data was collected by way of CATI telephone-interviews. The rate of return of the field study comes close to 20 per cent (this is difficult to determine exactly, because some of the firms were interviewed on the telephone). So far, data collection was conducted in one wave (though builds upon a prior field study involving foreign invested subsidiaries in CEECs in 2002 and 2003). The resulting cross-sectional database does however contain some lagged variables, where questions were asked for the situation in 2002 and 2005, as the last available complete financial year (e.g. for sales, employment, R&D). This restricts the analysis to a rather static analysis even though IPR regimes have dynamically evolved over a relatively short period of time. However, as we interrogated firms in their behaviour in a particular point of time and because we link this to the state of the art in the countries' IPR regimes at the same point of time, a static analysis may be justified.

The database is in fact representative of the whole population of foreign invested subsidiaries in terms of shares of industrial branches and is the first of its kind to allow detailed structural, technological, and governance analyses of foreign investors in a selection of Central East European and East German manufacturing industries. In this analysis, we however only use the data for Poland, Croatia, Romania, and Slovenia (with a total number of observations of 514). East Germany is not considered, because we may assume that the quality of the IPR system in this region corresponds to the one of West Germany and is hence very high. Alas, we are interested in the characteristics and behaviour of foreign investment subsidiaries in host economies with an IPR regime-gap vis-à-vis West European countries: in the group of countries that form part of our analysis, the IPR regime is clearly weaker than in the typical home countries of foreign investors.

Because these countries were virtually closed economies with respect to foreign investment from the West before 1989 (Meyer 1995; Dunning and Rojec 1993; Hunya 1997), our dataset consists predominately of investments undertaken after 1989: in fact, only

5 In our database, a foreign owner or shareholder can be a person, an industrial firm, a financial investor, or a foundation abroad.

eight investments in our dataset were made before 1989 (of which are five into East Germany in the second half of the 1980s): Amongst our countries, Slovenia was probably the most protective of FDI and nevertheless had accumulated an FDI stock of nearly 9.5 per cent of GDP by 1995 and nearly 21 per cent by 2003. Romania started to receive noticeable amounts only after 1996 and accumulated a comparable stock by 2003. Poland experienced large FDI-inflows right after the start of the transition process whilst Croatia started to receive noticeable amounts only after 1995. Still, Croatia's stock per GDP in 2003 already surpassed that of Poland with nearly 32 per cent and nearly 24 per cent respectively.[6] Of course, Poland and Romania are much larger economies than Croatia and Slovenia with Croatia and Slovenia around half the size of Romania's GDP and around one eighth of Poland's GDP.

In the database, we define a proxy for foreign invested subsidiaries that can be assumed to be particularly sensitive to IPR protection. This proxy forms the numerical sum of two dummy-variables from the database. The proxy ranks between values of 0 and 2, whereby the number increases with the assumed sensitivity of the firm (*IPR_sensitivity*). We determine the degree of firm-sensitivity to IPR protection:

**1** **the "acquisition and purchase of external knowledge from abroad" (***d_Aquisition***) is considered as a particularly important source for its R&D and innovation;**

**or**

**"existing technology of your TNC group embodied in products you already produce without substantial adjustments" (***d_TechGroup***) is considered as a particularly important source of technological knowledge for its R&D or innovation activities;**

**2** **(***d_Aquisition***) and (***d_TechGroup***) are both considered as particularly important sources at the same time;**

**0** **if neither (***d_Aquisition***) or (***d_TechGroup***) are considered as particularly important sources.**

The total number of 514 subsidiaries in Central East Europe breaks down into 219 most sensitive subsidiaries (*IPR-sensitivity* = 2), 141 with a medium level of sensitivity, and the remaining 91 subsidiaries that are not so easily influenced by the quality of the IPR regime (see Table 1). In terms of host countries for the FDI subsidiaries, Romania assumes the largest share with 43% or 220 subsidiaries, and Slovenia is the lowest with 8% and 40 observations. Within countries, the highest shares for the group of most sen-

6 Whilst Slovenia and Croatia both belonged to former Yugoslavia and therefore had more elements of a market economy than in our two other countries, Croatia's economic development and systemic transformation was retarded significantly during war time.

sitive subsidiaries are in Croatia with 50% and Poland with 79%. In Slovenia, the three sensitivity-groups are of equal size, and in Romania, the largest group has a medium level of sensitivity.

To test our hypothesis, we use ten factors (the strategic investment motives of the foreign investor, R&D intensity, innovation-intensity, equity share held by the foreign investor, the level of autonomy of the subsidiary in deciding upon business functions, cooperation within versus outside the TNC network, the WEF-indicator for the strength of the national IPR regime, a classification of countries of origin according to their respective strengths of IPR regimes, and finally age and size of the subsidiary) and four sets of dummies (a dummy for true MNCs with subsidiaries in more than two foreign host countries, a dummy for greenfield investments, and finally two sets of dummies for industrial sectors).

Table 1:
Stylised facts: IPR sensitivity by countries

| | Croatia | | Poland | | Romania | | Slovenia | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | obs | share | obs | share | obs | share | obs | share | obs | share |
| *d_Aquisition* = 0 | 55 | 41% | 14 | 13% | 106 | 57% | 19 | 56% | 194 | 42% |
| *d_Aquisition* = 1 | 79 | 59% | 94 | 87% | 80 | 43% | 15 | 44% | 268 | 58% |
| *d_TechGroup* = 0 | 47 | 35% | 12 | 11% | 65 | 34% | 15 | 44% | 139 | 30% |
| *d_TechGroup* = 1 | 88 | 65% | 94 | 89% | 124 | 66% | 19 | 56% | 325 | 70% |
| *IPR-sensitivity* = 0 | 33 | 25% | 4 | 4% | 43 | 24% | 11 | 33% | 91 | 20% |
| *IPR-sensitivity* = 1 | 32 | 24% | 18 | 17% | 80 | 44% | 11 | 33% | 141 | 31% |
| *IPR-sensitivity* = 2 | 66 | 50% | 83 | 79% | 59 | 32% | 11 | 33% | 219 | 49% |
| Total sample | 144 | 28% | 110 | 21% | 220 | 43% | 40 | 8% | 514 | 100% |

* Due to rounding off, the shares may not add up to 100%.

Source: IWH-FDI database.

As strategic investment motives of the foreign investor, we allow for a set of five motives (with the possibility of multiple motives, but all ranked), be they (i) to access a new market or to increase the existing share on the domestic market (*Market*), (ii) to follow foreign key clients that moved to your country (*Follow*), (iii) to increase efficiency across the foreign owner network, such as labour cost etc. (*Efficiency*), (iv) to access location-bound natural resources (*Resources*), and/or (v) to access location-bound knowledge, skills, or technology (*Technology*). Those motives relate to the strategic motive as of the time of the field study, i.e. 2006 and early 2007, and again may assume values between 1 for subsidiaries that hold that their investors value a particular motive as “not

important" to 2 for "little importance", 3 for "important", 4 for "very important", and 5 for "extremely important".

The indicator *R&D* is measured as the annual expenditure on R&D and innovation (including external R&D services) in 2005 as a percentage of total sales of the firm. *Innovation* is scaled 0 to 4, with 0 denoting no innovations between 2002 and 2005, 1 denoting either product innovations, process innovations, marketing innovations, or organisational innovations.[7] 2 denotes a random combination of two types of innovations during the period, 3 a random combination of three types, and 4 describes a subsidiary that has produced all four kinds of innovations. No distinction was made between differing intensities of innovation in terms of the total number of innovations generated.

Our indicator *Equity share* is the total share of equity held by the foreign investor in 2006 and early 2007. Next to equity share, we test corporate control between headquarter and subsidiary by way of autonomy vis-à-vis the foreign investor enjoyed by the subsidiary in deciding upon business functions. The extent of autonomy is proxied by another additive indicator generated from the sum of three dummies (*Autonomy*): each dummy depicts whether a specific business function is either undertaken by the foreign investor or by the subsidiary. The business functions considered are "basic and applied research", "product development", and "process engineering". The dummies assume a value of 1 if the function is undertaken totally or mainly by the subsidiary and 0 if the function is undertaken totally or mainly by the foreign investor. The autonomy-proxy hence assumes values between 0 and 3 with increasing levels of subsidiary-autonomy in business functions.

Our proxy for the technological cooperation of the subsidiary distinguishes between cooperation within the TNC network and cooperation outside the TNC network. Both forms of cooperation range from 1 for subsidiaries that view cooperation with either partner as "not important" to 2 for "little importance", 3 for "important", 4 for "very important", and 5 for "extremely important". A comparison is made between the relative firm-specific levels of importance attached to either partner and the proxy (*Coop-comparison*) assumes a value of −1 where cooperation within the TNC network is deemed to be less important than cooperation outside the network; a value of 0 where both levels of importance are equal and +1 where internal network cooperation is viewed as more important than external cooperation.

Further measures that control for firm-specific heterogeneity are the subsidiaries' sizes (in employment) and ages (in years since entry of the foreign investor into the subsidiary). Then, we include one indicator for the institutional environment, the quality or strength of the national IPR regime (*IPR country-index*), as estimated by the World Economic Forum (WEF) in its 'Protection of intellectual property' section of the

7 The technological indicators (innovations and R&D) have been collected according to the international guidelines of the Oslo-Manual and the Frascati-Manual.

2005/2006 Global Competitiveness Report: because we assume a high correlation between GDP per capita as an indicator of the level of economic development (regardless whether this is measured in Euros or in power-purchasing parities) and the strength of the respective country's IPR regime[8], we may treat this indicator as one that not only controls for country-specifics (as country-dummies would), but also includes a very important additional piece of information on country differences. This compares to the quality of the IPR regime in the country of origin (*Origin*): the variable classifies countries into three groups with increasing quality of IPR regimes: the first class assumes a value of 3 and includes the countries of Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Iceland, Ireland, Israel, Japan, Lichtenstein, Luxembourg, Netherlands, Norway, Portugal, Saudi Arabia, Spain, Sweden, Switzerland, Taiwan, and the US. The second class assumes a value of 2 and includes China, Cypress, Czech Republic, Greece, Hungary, India, Italy, Croatia, Malta, Mexico, Panama, Poland, Romania, Slovenia, Slovak Republic, and Turkey. Finally the third group with a value of 1 comprises Bosnia and Russia (obviously, only the countries are classified that form part in our database as countries of origin for investments in our selection of countries).

We use dummies to further control for firm heterogeneity and industry-heterogeneity: first, we distinguish between true multinational companies *d_MNE* (i.e. subsidiaries having establishments in at least one third country next to the host and the home country) that are particularly large (i.e. above 250 employees or 50 mil Euro turnover) and from subsidiaries with transnational investors with only one foreign market. Second, we identify true greenfield investments if the initial mode of entry of the foreign investor was a partial or full ownership in or of a completely new enterprise (*d_Green*).

Finally, we control for industry-differences in the sensitivity to the protection of knowledge ownership by use of two alternative sets of industry-dummies: the first set includes all individual industrial sector dummies that exist in our database. The second set is an alternative way to control for sector-specific heterogeneity that additionally allows us to test whether a specific group of sectors identified in the literature as particularly sensitive to IPR protection also holds in the case of our transition economies: the group of *d_Depend* consists of the three industries "chemicals and chemical products" (NACE 24), "machinery and equipment, not elsewhere classified" (NACE 29), and "electrical machinery and apparatus, not elsewhere classified" (NACE 31). The sectors typically considered as rather independent of the IPR system, grouped into the dummy *d_Independ*, includes "food products and beverages" (NACE 15), "basic metals" (NACE 27), and "other transport equipment" (NACE 35). Both dummies may be used simultaneously in the analysis, because they only cover the six most distinct of the 22 sectors that form part of our database.

8 In fact, we record a pairwise correlation coefficient of 0.979 for our set of countries.

# 5 Method of Analysis

The development of hypotheses already shows that there is no general comprehensive and closed model for the behaviour and characteristics of FDI subsidiaries in countries with differing IPR regimes. We therefore have to analyse in a rather explorative manner and even though our hypotheses are derived from theory and related empirical research, theories do not predict or explain particular directions of causality for any of our hypotheses. As a result, we cannot test regression models (e.g. probit or logit) and have to use correlation analysis, a somewhat weaker method of analysis and yet strong enough to identify significant relationships and find support or refute our hypotheses.

In order to make sure that the resulting correlations are not spurious, omitting third variables, we use a partial correlation method. This measures the degree of association between two variables, randomly selected from our list of factors, and removes the effect of the rest of the factors as controlling variables by holding them constant. This allows us to control for effects of third variables that may have an influence on both variables of a pairwise correlation. We specify several sets of correlation analysis as partial correlations, involving the indicators and control variables variably in full and in sub-groups. The robustness of our results in those correlation-groups can be tested by various extensions and alterations of factors and dummies included. Because some of our data is on an ordinal scale, we use partial rank correlations[9]:

$$\tau_{(X,Y)/U} = \frac{\tau_{X,Y} - \tau_{X,U} \cdot \tau_{Y,U}}{\sqrt{\left(1-\tau_{X,U}^2\right)\left(1-\tau_{Y,U}^2\right)}} \qquad \text{(i)}$$

with $X$ being the sensitivity of FDI subsidiaries to the strength of the IPR regime in the host economy, and Y the randomly selected variable from our list of factors. $U$ denotes the rest of our factors that are used as controlling variables. The partial correlation tests linear regressions between $X$ and $U$ as well as between $Y$ and $U$. The correlation coefficient $\tau_{(X,Y)/U}$ is the correlation between the residuals of the linear regressions.

In our partial correlation analysis, we test four correlations, the first (partial correlation 1) includes only the factors that we derive from the literature plus the control-factors and dummies. This will tell us whether the results and assumptions discussed in the literature are also valid for foreign investments in our selection of countries in Central East Europe. The factors in the analysis include the strategic motives of the foreign investor with a view on Hypothesis 1-4, R&D for Hypothesis 5, innovations for Hypothesis 6, the corporate control variable of equity share for Hypothesis 7a, the augmented country-dummy by use of the country-specific IPR-index, the IPR-indicator of the country of

9 Our statistical software STATA does not offer partial Spearman rank correlation. We therefore define rank orders for our variables in a first step (using the *egen, rank*-command) and run normal partial correlations in a second step.

origin in the three groups, the age, size, the dummy for true MNEs, the dummy for greenfield investments, as well as the individual industry dummies:

*IPR-sensitivity pcorr Market, Follow, Efficiency, Resources, Technology, R&D, Innovation, Equity share, IPR country-index, Origin, Age, Size, d_MNE, d_Green, Sector dummies* (ii)

The second correlation analyses (partial Correlation 2) tests the same factors but substitutes the individual sector dummies by the set of two sensitivity-classes of sector dummies, *d_Independ* and *d_Depend* to test whether the specific set of sectors identified in the literature as particularly sensitive to IPR protection also holds in the case of our transition economies:

*IPR-sensitivity pcorr Market, Follow, Efficiency, Resources, Technology, R&D, Innovation, Equity share, IPR country-index, Origin, Age, Size, d_MNE, d_Green, d_Independ, d_Depend* (iii)

The third correlation analyses (partial Correlation 3) returns to the individual sector dummies replacing the two sensitivity-classes of sector dummies and includes additionally the new corporate governance factor of *Autonomy* to test Hypothesis 7b and the new networking variable of *Coop-comparison* to test for hypothesis 8:

*IPR-sensitivity pcorr Market, Follow, Efficiency, Resources, Technology, R&D, Innovation, Equity share, Autonomy, Coop-comparison, IPR country-index, Origin, Age, Size, d_MNE, d_Green, Sector dummies* (iv)

The final correlation analyses (partial Correlation 4) tests the same specification as in Correlation Analysis 3 but again replaces the individual sector dummies by the two sensitivity-classes of sector dummies:

*IPR-sensitivity pcorr Market, Follow, Efficiency, Resources, Technology, R&D, Innovation, Equity share, Autonomy, Coop-comparison, IPR country-index, Origin, Age, Size, d_MNE, d_Green, d_Independ, d_Depend* (v)

Before we actually start with our partial correlation analyses, we test for significant and high rank-pairwise-correlations between all our factors. This is to ensure that information contained within one factor is not significantly duplicated by another. The individual results for all factors therefore contain information independent from the other factors. Table 2 shows that no significant Spearman rank correlations are in fact higher than 0.5, so all variables may be included in the partial correlation analyses. The highest correlation (with a coefficient of 0.44) is between the IPR country-index and *Origin*, our indicator for the strength of the IPR regime in the country of origin of the foreign investor (which suggests that firms that invest in Romania and Croatia, as the countries with the lowest IPR country-indices, appear to originate from countries with likewise lower levels of IPR protection – not a surprising result).

Table 2:
Pairwise correlation analysis of all factors

| obs: 322 | Market | Follow | Efficiency | Resources | Tech-nology | R&D | Inno-vation | Equity share | Auto-nomy | Coop-comparison | IPR country-index | Origin | Age | Size |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Market | 1 | | | | | | | | | | | | | |
| Follow | 0.2721* | 1 | | | | | | | | | | | | |
| Efficiency | 0.0851 | 0.2104* | 1 | | | | | | | | | | | |
| Resources | 0.2149* | 0.2322* | 0.1768* | 1 | | | | | | | | | | |
| Technology | 0.1443* | 0.1545* | 0.3209* | 0.2769* | 1 | | | | | | | | | |
| R&D | 0.0130 | 0.1308* | 0.0355 | 0.1275* | 0.1408* | 1 | | | | | | | | |
| Innovation | 0.1133* | -0.0175 | 0.1428* | 0.1542* | 0.1273* | 0.3463* | 1 | | | | | | | |
| Equity share | 0.0171 | -0.0584 | 0.1169* | 0.0202 | -0.1024* | -0.0385 | -0.0275 | 1 | | | | | | |
| Autonomy | 0.0781 | 0.0252 | -0.1409* | 0.0252 | 0.0794 | 0.1693* | 0.1156* | -0.2578* | 1 | | | | | |
| Coop-comparison | 0.0335 | 0.0156 | 0.0755 | 0.0268 | -0.0503 | -0.0231 | 0.0788 | 0.1228* | -0.2348* | 1 | | | | |
| IPR country-index | 0.0231 | -0.0925* | 0.0265 | -0.1195* | -0.0426 | -0.0957* | -0.0355 | 0.0575 | -0.2015* | 0.1210* | 1 | | | |
| Origin | -0.0470 | -0.0278 | 0.0126 | 0.0084 | -0.0423 | 0.0039 | 0.0116 | -0.0288 | -0.1514* | 0.2087* | 0.4372* | 1 | | |
| Age | 0.0313 | -0.0597 | -0.0453 | 0.0784 | 0.0186 | -0.0283 | -0.0059 | 0.0775 | -0.0317 | 0.0458 | 0.1896* | 0.0207 | 1 | |
| Size | -0.0951* | 0.0076 | 0.0627 | 0.1188* | 0.0535 | 0.1027* | 0.1841* | 0.0283 | 0.0055 | 0.0836 | -0.0774 | 0.1200* | 0.1145* | 1 |

Coefficients presented with a star present statistically significant pairwise correlations at the 0.1 level.

Source: IWH-FDI database.

# 6 Results of Analysis

The results of our four partial correlation analyses show a large extent of consistency with respect to variables tested as being significant and their signs (see Table 3): only in the cases of the strategic motive of following key clients, the size of subsidiaries, and the greenfield-dummy are variables not consistently significant in all correlation-specifications. Moreover, we are able to test quite a number of significant variables amongst the set of factors tested. The number of cases considered in the analysis (i.e. omitting the cases with missing values) is also quite large. All this suggests that results are rather robust and warrants further discussion of results.

The separate treatment of the sector dummies between the specifications 1/3 against 2/4 (substituting individual sector dummies with the two-group dummies) likewise did not change results in a structured way – both kinds of specifications appear to produce valid results. The fact that both of the two-group sector dummies for independent vs dependent sectors turn out to be insignificant further suggests that the groupings identified by the literature do not appear to apply to our selection of transition economies.

The discrimination between significant and insignificant results and the signs of significant results provide us with some indication of the hypotheses to be tested. The significant and positive results for the strategic motive of market access in all four specifications lend support to Hypothesis 1, suggesting that, in an environment of weak IPR regimes, the more important the strategic motive of the foreign investor to access a new market or to increase the existing share on the domestic market, the more it may afford to be sensitive to the strength of the IPR system in the host economy (i.e. either receive technology from the foreign investor or purchase technology itself). Support for our Hypothesis 2 is only found in the first of our correlation analyses and hence remains an open issue – a result too weak to follow up on this.

We do however consistently find support for our Hypothesis 3 on location-bound natural resources: this strategic motive appears to coincide with higher levels of IPR sensitivity. For Hypothesis 4, we would have expected significant and negative correlation coefficients, but none of the correlation specifications turned out to be significant, we hence are not able to find support for this hypothesis.

Do foreign subsidiaries that are particularly sensitive to IPR protection conduct more technological activities (i.e. innovation and R&D) or rather less? The literature remains ambiguous, yet our results offer a consistent answer for the case of FDI in our transition economies: we obtain a significant opposite (positive) sign. The more subsidiaries are sensitive to IPR protection, the more likely they are to produce innovations and spend on R&D per sales. This suggests that both our Hypotheses 5 and 6 should be refuted.

Table 3:
Results of the partial rank correlation analysis

| | Partial correlation 1 | | Partial correlation 2 | | Partial correlation 3 | | Partial correlation 4 | |
|---|---|---|---|---|---|---|---|---|
| Variables | correl. | signif. | correl. | signif. | correl. | signif. | correl. | signif. |
| Market | **0.18** | 0.002 | **0.21** | 0.000 | **0.21** | 0.001 | **0.23** | 0.000 |
| Follow | **0.10** | 0.078 | 0.07 | 0.198 | 0.09 | 0.132 | 0.06 | 0.328 |
| Efficiency | 0.02 | 0.774 | 0.04 | 0.523 | -0.01 | 0.861 | 0.01 | 0.885 |
| Resources | **0.16** | 0.007 | **0.17** | 0.003 | **0.17** | 0.004 | **0.18** | 0.003 |
| Technology | -0.03 | 0.655 | -0.05 | 0.381 | -0.02 | 0.796 | -0.04 | 0.517 |
| R&D | **0.16** | 0.007 | **0.15** | 0.007 | **0.19** | 0.001 | **0.19** | 0.001 |
| Innovation | **0.26** | 0.000 | **0.28** | 0.000 | **0.27** | 0.000 | **0.29** | 0.000 |
| Equity share | 0.07 | 0.208 | 0.07 | 0.200 | 0.01 | 0.897 | 0.02 | 0.766 |
| Autonomy | | | | | **-0.21** | 0.001 | **-0.20** | 0.001 |
| Coop-comparison | | | | | **0.17** | 0.005 | **0.17** | 0.004 |
| IPR country-index | **0.32** | 0.000 | **0.34** | 0.000 | **0.33** | 0.000 | **0.32** | 0.000 |
| Origin | 0.00 | 0.989 | 0.01 | 0.893 | -0.03 | 0.676 | -0.02 | 0.747 |
| Age | **-0.15** | 0.009 | **-0.15** | 0.008 | **-0.17** | 0.006 | **-0.15** | 0.008 |
| Size | **0.13** | 0.024 | **0.11** | 0.045 | **0.11** | 0.068 | 0.09 | 0.124 |
| d_MNE | **-0.12** | 0.046 | **-0.11** | 0.052 | **-0.12** | 0.045 | **-0.12** | 0.033 |
| d_Green | 0.09 | 0.139 | **0.10** | 0.077 | 0.04 | 0.475 | 0.05 | 0.376 |
| Sector dummies | yes | | no | | yes | | no | |
| d_Independ | | | -0.01 | 0.804 | | | 0.00 | 0.950 |
| d_Depend | | | 0.03 | 0.564 | | | 0.02 | 0.697 |
| observations | 327 | | 326 | | 308 | | 308 | |

Coefficients presented in bold are statistically significant partial correlations at the 0.1 level.

Source: IWH-FDI database.

Foreign parents investing in weaker IPR regimes may use corporate control mechanisms to prevent the unlawful leakage of intellectual property. The two most important corporate governance instruments, equity share and autonomy in business functions, are considered in our analysis. In fact, we are interested in both the relationship between subsidiary-sensitivity and each of the two instruments separately as well as in the relationship between the two instruments: are they substitutional or do they rather complementary? The results suggest that equity share is not significantly correlated with subsidiary-sensitivity, whereas autonomy consistently is. This tells us that a higher equity share is not typically used as corporate control instrument to protect the investor's ownership advantage. Limiting subsidiary-autonomy, however, does appear to be a significant instrument. With respect to the relationship between the two, we did test each of the instruments individually (not reported): autonomy always turned out to be significant and equity share never. This means that we are unable to test for either substitutionality nor complementarity for foreign direct investors in our transition economies. In terms of our hypotheses, this means that we have to refute Hypothesis 7a whilst we find some indication for Hypothesis 7b, which is new to the literature.

As a further addition to the body of knowledge on the FDI-IPR issue, we tested whether subsidiaries that are particularly sensitive to IPR protection would attach less weight on cooperating with the local host economy innovation system, here proxied by unspecified other domestic firms and other domestic organisations (Hypothesis 8). In fact, our partial correlation analyses suggest that this hypothesis may in fact be true: we consistently find significant positive coefficients. In terms of economic policy, this result has the important implication that in order to promote technology and knowledge transfer from foreign direct investment subsidiaries, a sufficiently high level of IPR protection should be guaranteed. Our analysis, however, does not allow us to make a statement on the optimal strength of the IPR regime.

From the results, we also find support for the case that the stronger the IPR regime in a given host economy (denoted by the factor *IPR country-index*), the more will FDI receive sensitive technology from the parent company (ownership advantage) or will be willing to pay for sensitive technology worthy of protection – yet again an obvious indication for the kind of economic policy that aims at exploiting the potentials for technology transfer via FDI. With respect to our test for the influence of the strength of the IPR regime in the foreign investor's own home country, our results do not allow us to draw any conclusions, all coefficients remain insignificant. This was already indicated by the pairwise correlation analysis, where the IPR regimes of host and home economies showed a high, positive, and significant correlation.

What this analytical method left unanswered so far is the characterisation of industries according to their specific sensitivity to IPR protection in the transition economies of CEE – we were able to refute the list of industries from the literature but we still remain to provide an alternative list for our transition economies. There could be different rea-

sons for this finding. The distinction between IPR-sensitive sectors and IPR-insensitive sectors was developed in the mid 1980 and technological evolution in those industries may contort the attempt to make a clear distinction between the former IPR- sensitive and IPR-insensitive sectors provided by the industries. If the different pace of the technological evolution between sectors over the last decades is indeed the answer for inconsistencies between the IPR-sensitivity of the literature and the IPR-sensitivity found in our dataset, then it is insufficient to add one by one new studied sectors to the group of sensitive or insensitive sectors. To account for the factor of time, it is rather needed to run a whole new analysis for the IPR-sensitivity by sectors in distinct time intervals.
Such a repetition of Mansfield sector analysis could make a case for the relevance of the factor time in relation with the IPR-sensitivity of different industries. Another possible explanation for the difference between the "traditional" IPR-sensitivity of sectors in the literature and the IPR-sensitivity of sectors found in our dataset is obviously the fact that the FDI subsidiaries are placed in transition economies of East Europe. The question arises, if there is a reason that those particular sectors in the observed countries behave differently towards FDI than their counterparts in other countries. Is there something special in East Europe that influences the sector behaviour? To address this question, further study is required.

Still, those differences do not produce a totally different picture in our data: some of the "traditional" industries remain IPR-sensitive, but new ones join this group whilst others appear not to be that sensitive any more or in the transition context (see Table 4). The often mentioned chemical and pharmaceutical industry (both included in "chemicals and chemical products", NACE 24) remains one of the most sensitive industries towards the IPR regime with an industry-average level of 1.82[10]. Beyond this, the sector-specific average indicator for IPR-sensitivity over all our FDI-subsidiaries turns out to be highest for the sector of "paper and paper products" (NACE 21). It should not be surprising that "manufacturing of medical, precision and optical instruments, watches and clocks" (NACE 33) also forms part of the sectors that are rather IPR-sensitive – both were not included in previous studies. The forth sector with a high sensitivity is the sector of "fabricated metal products, except machinery and equipment" (NACE 28) which also was not identified as particularly sensitive in the previous studies.

The four sectors with the lowest IPR-sensitivity in our study are "manufacturing of wood and wood products and articles of straw and plainting material" (NACE 20), "radio, television and communication equipment and apparatus" (NACE 32) (note that this industry is represented by only one firm), "wearing apparel; dressing and dyeing of fur" (NACE 18), and "office, accounting and computing machinery" (NACE 30). Amongst

10 The index assumes the highest value of 2, if all subsidiaries in this industry attach particularly high importance to first the acquisition of external knowledge as source for R&D and innovation and second to existing technology from the MNE group embodied in products already produced without substantial adjustments. The lowest value of 0 would signify that all subsidiaries do not attach significant importance to either source of knowledge.

those, "manufacturing of radio, television and communication equipment and apparatus" (NACE 32) is quite close to what the literature calls "electrical equipment" and holds as particularly IPR-sensitive.

Table 4:
Sectors according to their sensitivity to IPR protection (*IPR-sensitivity*)

| NACE Sector: Manufacturing of ... | Mean | obs. | C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|---|---|---|
| paper and paper products (21) | 1.82 | 11 | 0 | 22 | 0 | 11 | **67** |
| medical, precision and optical instruments, watches and clocks (33) | 1.63 | 8 | 0 | **60** | 0 | 0 | 40 |
| chemicals and chemical products (24) | 1.61 | 23 | 14 | 14 | 0 | 29 | 43 |
| fabricated metal products, except machinery and equipment (28) | 1.55 | 33 | 12 | 12 | 44 | 20 | 12 |
| other non-metallic mineral products (26) | 1.46 | 35 | 17 | 4 | 17 | 13 | **50** |
| basic metals (27) | 1.42 | 12 | 13 | 13 | 13 | 38 | 25 |
| furniture (36) | 1.42 | 26 | 30 | 13 | 35 | 13 | 9 |
| other transport equipment (35) | 1.33 | 9 | 14 | 14 | 29 | 43 | 0 |
| rubber and plastic products (25) | 1.32 | 25 | 29 | 19 | 14 | 14 | 24 |
| electrical machinery and apparatus, not elsewhere classified (31) | 1.32 | 34 | 11 | 11 | 15 | 37 | 26 |
| food products and beverages (15) | 1.28 | 60 | 9 | 9 | 45 | 23 | 14 |
| textiles (17) | 1.26 | 27 | 42 | 26 | 16 | 11 | 5 |
| motor vehicles, trailers and semi-trailers (34) | 1.25 | 16 | 0 | 7 | 21 | 21 | **50** |
| Recycling (36) | 1.25 | 4 | 25 | 0 | 0 | 25 | **50** |
| machinery and equipment, not elsewhere classified (29) | 1.23 | 35 | 14 | 7 | 18 | 32 | 29 |
| Publishing, printing and reproduction of recorded media (22) | 1.11 | 9 | 14 | 14 | 29 | 29 | 14 |
| leather, luggage, handbags, saddlery, harness, and footwear (19) | 1.00 | 17 | 21 | 43 | 14 | 21 | 0 |
| wood & wood products, articles of straw & plainting material (20) | 1.00 | 18 | **50** | 7 | 0 | 36 | 7 |
| radio, television and communication equipment and apparatus (32) | 1.00 | 7 | 25 | 0 | **50** | 0 | 25 |
| wearing apparel; dressing and dyeing of fur (18) | 0.83 | 36 | 36 | 15 | 27 | 12 | 9 |
| office, accounting and computing machinery (30) | 0.00 | 1 | **100** | 0 | 0 | 0 | 0 |

C1 through C4 are the percentages of firms belonging to the specific four groups in the cluster analysis. The figures in bold represent a dominant (i.e. >50%) allocation of firms in one group. C1 is the least sensitive group whilst C2 and C5 have the highest averages of *IPR-sensitivity*. C3 and C4 are very close to each other and assume the middle ground.

Source: IWH-FDI database.

A further hierarchical cluster analysis (with the Gower-specification, because we have mixed data between binary, discrete, and continuous variables) uses the factors that turned out to be significant in the partial correlation analysis to group firms into industries according to their common behaviour and characteristics with respect to IPR protection. This way, we are able to use all information that plays a role in determining corporate control of subsidiaries and the selection of their trade and networking partners for their own technological activity with respect to the strength of IPR protection in the host economy. The results are hence richer than the pure average-measure for *IPR-sensitivity*

and produces a more robust measure of industry-specific levels of sensitivity to IPR protection in transition economies. The cluster analysis was cut off at 5 groups[11], whereby C2 and C5 have a higher average IPR-sensitivity index with 1.771 and 1.587 respectively, C1 has the lowest average sensitivity-index with 0.348, and C3 and C4 are somewhere in the middle with indices of 1.291 and 1.351 respectively. We hence use C2 and C5 as groups of firms with above-average sensitivity to IPR protection and contrast this to C1 as the group with below-average sensitivity-industries.

The results of the cluster analysis tell us that the five industries of "paper and paper products" (NACE 21) and "medical, precision and optical instruments, watches and clocks" (NACE 33), "other non-metallic mineral products" (NACE 26), "motor vehicles, trailers and semi-trailers" (NACE 34), and "Recycling" (NACE 36) belong to the two most sensitive clusters: of all firms in these industries, more than 50 per cent appear in the clusters C2 and C5. In comparison to the analysis using *IPR-sensitivity* averages, the cluster analysis allocates only 43 per cent of firms in NACE 24 (which includes chemical and pharmaceutical industries) into the second most sensitive cluster and 14 per cent in the most sensitive cluster. This constitutes a close miss with respect to our 50 per cent criterion. NACE 21 and NACE 33 appear to be sensitive in both analyses.

Amongst the insensitive sectors, our criterion for the cluster analysis only identifies "wood & wood products, articles of straw & plainting material" (NACE 20) and "office, accounting and computing machinery" (NACE 30). This supports the results of the analysis using *IPR-sensitivity* averages, even though NACE 32 and NACE 18 are not identified in our cluster analysis. In sum, of the three "traditional" IPR-sensitive sectors, only one corresponds to our results, and all "traditional" less sensitive sectors appear in the middle-ground in our analysis.

11 The decision to cut off at 5 groups is guided by the *Calinski and Harabasz* (1974) pseudo-F and *Duda and Hart's* (1973) Je(2)/Je(1), both of which start to strongly decline after 5 clusters, combined with the rule by Duda/Hart pseudo T-squared, which shows a low plateau at 5 groups and starts to rise strongly for 6 groups (the next local minimum appears for 11 groups). See the annex for the respective rule-tables and the usual dendogram.

# 7 Discussion of Results in Light of Economic Policy

The issue of FDI and in fact technology attraction is typically focussed upon issues related to the technological ability of the host economy, including absorptive capacities (Cohen and Levinthal, 1990), on endowment with human capital (see e.g. UNCTAD 2005, pp. 184, 203-206), on (backward) linkages and spillovers (Cantwell and Piscitello 2002), as well as the capabilities of the national and regional innovation system and their ability to integrate the business sector, research and education institutions, as well as the administration and government sectors into a functioning network (triple helix: Etzkowitz 2008). Important as these issues certainly are, our paper takes an institutional focus on IPR regimes, an issue largely overlooked in this kind of literature.

Where IPR is considered in the political economy of development studies, there is an open debate about the pros and cons of a regulatory regime that effectively and strictly enforces the protection of intellectual property rights: it is argued that it would be to the detriment of (least) developing countries to enforce a strong IPR regime, because this could deprive them of access to modern knowledge and technology (e.g. Legèr 2007). Some of the literature argues that catching up in the newly industrialised countries of Central East Asia was build to some degree on imitation of existing (and insufficiently protected) knowledge (for a review and discussion of this, see: Emmert et al. 2005, p. 40-42).

However, our results show that in the case of transition economies, a strong IPR regime is –overall– beneficial for an economy hosting foreign direct investment subsidiaries: first, we find some indication that the stronger the IPR regime in the host economy, the more will subsidiaries tend to receive sensitive knowledge and technology from the foreign parent and tend to purchase technology from abroad. We also find support for the case that subsidiaries, that are thereby rather sensitive to IPR protection, also tend to be technologically more active. In addition, we find that our subsidiaries may have entertained more cooperation activities with partners in the host economy and outside their transnational investors' network, if the IPR regime would have been stronger. They may also have been able to act more autonomously with respect to their own business functions. Both would have resulted in more interesting and hence valuable FDI for the host economy. Our results also show that a strong IPR regime may not be as important an issue for market-seekers and natural resource-seekers than for foreign investors that aim to benefit from location-bound knowledge, skills, and technology.

It is important to note, however, that an IPR regime alone will not be sufficient to tap the full potential of international technology transfer. Rather, a mix of other policies is needed which could include, following Maskus (2000, p. 2), "promoting political stability, encouraging flexible labor markets and building labor skills, continuing to liberalize markets, and developing forward-looking regulatory regimes in services, investment, intellectual property, and competition policy." Other instruments to attract FDI may in-

clude the host country's guarantee of good infrastructure supplies, transparency in policies and regulations, and stability in the government (Kalemli-Oczan et al. 2003), while Grubert and Mutti (1991) find evidence that FDI flows react more to international variations in taxes and incentives.

Some of these possible conditions to attract inflowing FDI that carries sensitive knowledge is already fulfilled in most transition economies of Central East Europe: membership in the European Union grants transnational companies access to the large EU markets that are not only fairly liberalised and deregulated but also offer political stability and a modern infrastructure. Alas, the strength of IPR regimes is lower in this region as compared to the Western EU member countries. The design of a IPR system conducive to technological development is not at all a straight-forward task: the IPR regime has to find a balance between the guarantee for an inventor to exploit his invention (which often involve, but do not necessarily have to generate in all cases monopoly market positions that result in high prices, limited access, and exclusive use of technologies, or in patent blocking and fencing UNCTAD 1996). On the other side, the IPR regime has to make sure that the benefit of innovation for the society is higher than the costs of the monopoly involved.

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# Annex

Table A1:
Calinski/Harabasz pseudo-F

| Number of clusters | Calinski/ Harabasz pseudo-F |
|---|---|
| 2 | 20.62 |
| 3 | 32.69 |
| 4 | 32.23 |
| 5 | 32.43 |
| 6 | 30.02 |
| 7 | 28.30 |
| 8 | 27.01 |
| 9 | 25.42 |
| 10 | 24.77 |
| 11 | 24.36 |
| 12 | 22.64 |
| 13 | 22.23 |
| 14 | 21.69 |
| 15 | 21.14 |

Table A2:
Duda/Hart-rule

| Number of clusters | Duda/Hart | |
|---|---|---|
| | Je(2)/Je(1) | pseudo T-squared |
| 1 | 0.9433 | 20.62 |
| 2 | 0.8241 | 41.40 |
| 3 | 0.8289 | 30.34 |
| 4 | 0.8456 | 22.82 |
| 5 | 0.8402 | 14.64 |
| 6 | 0.7856 | 18.28 |
| 7 | 0.8516 | 12.55 |
| 8 | 0.8583 | 12.05 |
| 9 | 0.7441 | 13.07 |
| 10 | 0.7991 | 11.56 |
| 11 | 0.8351 | 5.53 |
| 12 | 0.8185 | 9.54 |
| 13 | 0.8033 | 9.06 |
| 14 | 0.8005 | 9.22 |
| 15 | 0.7360 | 9.69 |

Figure A1:

Dendogram for the cluster analysis